Borehole Disposal of Disused Sealed Radioactive Sources: Dose and Thermal Modeling and Material Testing to Support a Modified BOSS Concept

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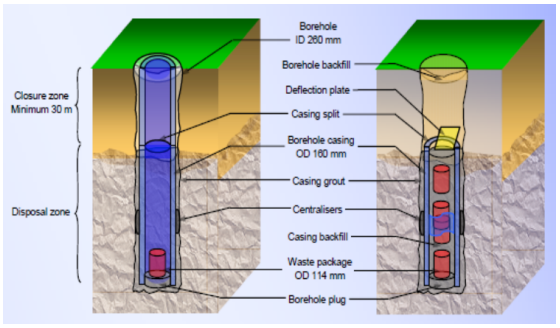

Borehole disposal of Sealed Radioactive Sources (BOSS) Concept (after International Atomic Energy Agency (IAEA) conceptual model)

Technical Summary

This objective of this project is to collaborate with our international partner to support borehole designs by applying SRNL experience in dose and thermal modeling to predict radiation fields and thermal transients resulting from disposal of gamma emitting sources in moderate depth (300 m) boreholes in bedrock. In addition, complementary SRNL and IPEN expertise in testing and material performance will be applied to evaluating cement-based casing grouts and waste package stabilizing grouts for these boreholes.

Accelerated test protocols will be evaluated utilizing multi-component test coupons subjected to granitic brine and gamma radiation (^{60}Co) temperature derived from the dose and thermal modeling. Evaluation of these coupons will focus on micro- and nano-characterization of interfacial regions rather than on bulk properties of the individual materials.

Barrier and seal options were evaluated for the Brazilian borehole concept. Thermal transient modeling based on dose and environmental parameters was developed for intermediated depth borehole disposal which can be used to optimize source loading and waste package configuration in the boreholes. Seal failure detection methodology and options for pilot borehole testing was also proposed.

Path Forward

- Apply SRNL dose and thermal models for the Brazilian modified BOSS concept to optimize borehole waste package and loading configuration design.
- Fabricate multicomponent test cylindrical coupons for accelerated testing Granite – grout – stainless steel – Granite brine system.
- Perform accelerated testing in ^{60}Co gamma radiation field.
- Characterize coupons with emphasis on interface alteration using micro and nano-techniques.
- Propose conceptual design for Brazil to evaluate borehole material performance under realistic conditions.

Key Accomplishments

- Technical basis utilizing SRNL modeling tools and expertise were applied to waste package loading and distribution in a borehole based on isotope inventory, dose and heat generation calculations, and granite and material properties.
- The IPEN borehole grout mix design was modified based on input from SRNL. The modified mix is consistent with the mix identified by the IAEA for BOSS applications.
- Accelerated test protocols for borehole materials were identified
- Two papers summarizing results were prepared and accepted for WM Symposium 2017 "Thermal Modeling Study for Geologic Borehole Conceptual Design" and "Requirements, Functions, and Test Methods for Cementitious Materials for Borehole Disposal."

Key Benefits

- Development of technical data and test methods to validate DOE borehole design for sealed sources, high gamma medical isotope production wastes and other high activity LLW.
- Thermal transient modeling based on dose and environmental parameters was used to optimize source loading and waste package configurations.
- Accelerated performance testing protocols for complex composite systems was proposed and will be evaluated in future work.
- SRNL and IPEN professionals and graduate students gained practical experience in applied R&D to address radioactive waste disposal needs.

For more information on this project or the EM International Program

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